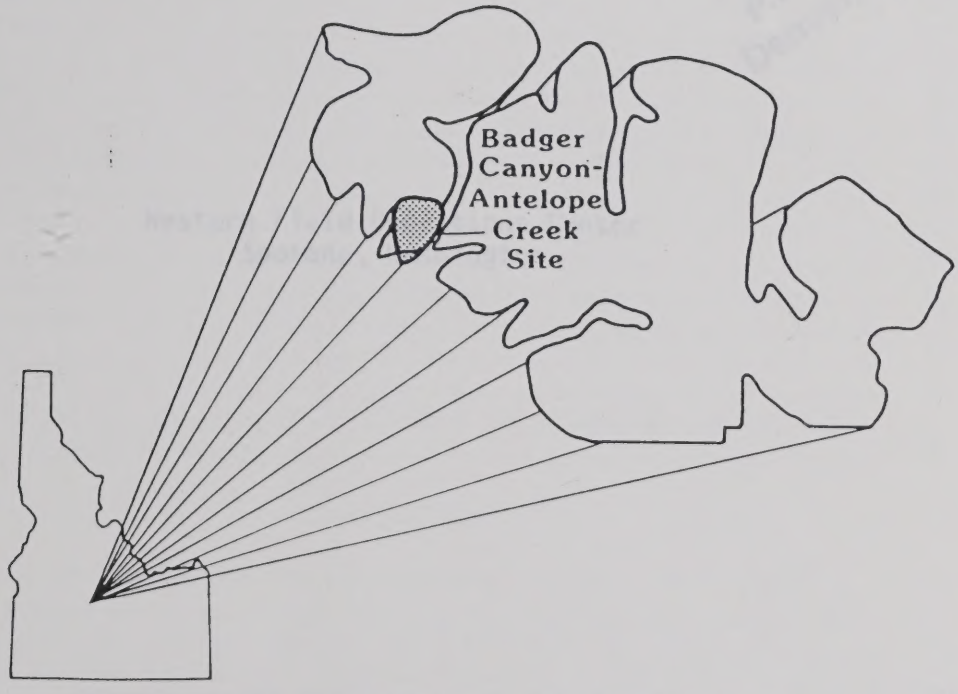
BLM LIBRARY
88068490

MLA 40-86

Mineral Land Assessment/1986
Open File Report

Mineral Resource Assessment of The Badger Canyon-Antelope Creek Site-Specific Study Area, Boulder-Pioneer Wilderness Study Area, Blaine County, Idaho



BUREAU OF MINES

UNITED STATES DEPARTMENT OF THE INTERIOR

TN
23
.M11
no.
86-40

#904606220
1088068490
Samuel W. McNary
TN
23
.M11
no.
86-40

MINERAL RESOURCE ASSESSMENT OF THE BADGER CANYON-ANTELOPE CREEK SITE-SPECIFIC STUDY AREA, BOULDER-PIONEER WILDERNESS STUDY AREA, BLAINE COUNTY, IDAHO

By Samuel W. McNary

BLM Library
Denver Federal Center
Bldg. 50, OC-521
P.O. Box 25047
Denver, CO 80225

Western Field Operations Center
Spokane, Washington

UNITED STATES DEPARTMENT OF THE INTERIOR
Donald P. Hodel, Secretary

BUREAU OF MINES
Robert C. Horton, Director

CONTENTS

	Page
Abstract	5
Introduction	6
Purpose	6
Location and access	6
Previous work	9
Acknowledgments	9
Mining history	9
Geology	10
Description of rock units	10
Structure	12
Mineral deposits	13
General	13
Results of previous work	14
Present U.S. Bureau of Mines study	14
Soil samples	14
Statistical interpretation of analytical data	16
Geochemical distribution of individual elements in soils	20
Gold	20
Silver	20
Copper	20
Lead	20
Zinc	20
Molybdenum	22
Arsenic	22
Antimony	22
Vanadium	22
Mercury	22
Rock samples	22
Conclusions	23
References	24
Appendix.--Chemical analyses of soil and rock samples collected during site-specific study	25

ILLUSTRATIONS

1.	Index map of the Badger Canyon-Antelope Creek site-specific study area	7
2.	Topographic map showing Badger Canyon-Antelope Creek area	8
3.	Geologic map of the Badger Canyon-Antelope Creek area	11
4.	Cumulative frequency distribution for gold and silver in soil samples	17
5.	Cumulative frequency distribution for antimony and arsenic in soil samples	18
6.	Cumulative frequency distribution for vanadium and zinc in soil samples	19

TABLES

Page

1. Elemental concentration of stream sediments and mineralized rock samples collected by the U.S. Geological Survey from the Badger Canyon-Antelope Creek drainages..... 15
2. Summary of soil sample statistical data: Badger Canyon-Antelope Creek area..... 21

A-1. Analyses of soil samples collected along the ridge crest between Antelope Creek and Badger Canyon..... 25

A-2. Analyses of rock samples collected from old prospects in the Badger Canyon drainage..... 30

UNIT OF MEASURE ABBREVIATIONS USED IN THIS REPORT

ft	foot	oz	ounce
in	inch	pct	percent
lb	pound	ppm	part per million
mi^2	square mile	tr oz/st	troy ounce per short ton

MINERAL RESOURCE ASSESSMENT OF THE BADGER CANYON-ANTELOPE CREEK SITE SPECIFIC STUDY AREA, BOULDER-PIONEER WILDERNESS STUDY AREA, BLAINE COUNTY, IDAHO

By Samuel W. McNary[1]

ABSTRACT

In August 1984 the U.S. Bureau of Mines conducted a study of the mineral resource development potential of the Badger Canyon-Antelope Creek area, within the Boulder-Pioneer wilderness study area, about 5 miles northeast of Ketchum, ID. The purpose of this study was to investigate in greater detail an area which was designated by the U.S. Geological Survey (USGS) and the Bureau as having a moderate mineral resource potential for zinc, molybdenum, lead, and silver, and a low potential for copper.

One hundred twenty-eight soil samples were taken along a 6,250-ft traverse on the ridge separating Badger Canyon and Antelope Creek. Five rock samples were collected from old prospect pits and mineralized outcrops. All samples were analyzed for gold, silver, copper, lead, zinc, molybdenum, arsenic, antimony, vanadium, and mercury.

The metal concentrations in the soil samples along the traverse are irregularly distributed. Samples collected near old prospect pits tend to be high in lead and zinc, undoubtedly a reflection of underlying galena- and sphalerite-bearing quartz veins. All of the copper and mercury values in the soils are less than the detection limit, as are most of the lead, molybdenum, and antimony values.

Except for lead and zinc values, the metal concentrations in the rock samples are low. Galena and sphalerite were observed in quartz vein samples collected at the old prospects.

The results of the study indicate that the galena-sphalerite-bearing quartz veins and veinlets are too narrow, widely-spaced, and low in metal values to be economic. Low concentrations of metals in the soil and rock samples, combined with the lack of major mining activity in the past, indicate that the area has a low likelihood for economic development.

[1]Physical scientist, Western Field Operations Center, Bureau of Mines, Spokane, WA.

INTRODUCTION

Purpose

The Bureau will conduct detailed, site-specific mineral investigations of areas previously determined to have a high probability of containing significant mineral resources, with emphasis on strategic and critical minerals. The studies will estimate mineral endowment and the potential for economic development by private enterprise.

Most of the anomalous mineral occurrences have been found by regional exploration techniques, such as airborne geophysics, stream sediment and pan concentrate sampling, or sampling mineralized surface outcrops. A few site-specific areas have been selected on the basis of past prospecting activity, such as the presence of adits, trenches, or pits. Further studies of these areas would entail looking for extensions of known mineralized zones.

The Badger Canyon-Antelope Creek drainage was selected for site-specific examination because it is adjacent to active claims in nearby Lake Creek, contains a number of old prospects, and lies within the Boulder-Pioneer wilderness study area. According to the USGS and the Bureau (9, pl. 1),[2] the site has a moderate mineral resource potential for zinc, molybdenum, lead, and silver, and a low potential for copper. This site has additional advantages of (1) being readily accessible, and (2) having relatively gentle slopes with moderate brush cover which would permit rapid soil sampling.

[2]Underlined numbers in parentheses refer to items in the list of references preceding the appendixes at the end of this report.

Location and Access

The Badger Canyon-Antelope Creek site-specific study area lies about 5 miles northeast of Ketchum, ID, opposite Corral Creek on the northwest side of Trail Creek Canyon (fig. 1). It is in the Sawtooth National Forest, just inside the boundary of the proposed Boulder-Pioneer wilderness area, and encompasses the ridge between Badger Canyon and Antelope Creek, extending northward from the bottom of Trail Creek Canyon to the Trail Creek-Lake Creek divide (fig. 2).

Excellent access to the study area is provided by a paved all-weather road which leads from Ketchum, ID, to the foot of Trail Creek summit, about 5 miles east of Corral Creek. A rough dirt road leading from the paved road just west of the highway bridge across Trail Creek can be negotiated by 4-wheel-drive vehicles for about 1/4 mile up Badger Canyon. An old pack trail winds up the Antelope Creek drainage from Trail Creek; however, this trail is mostly overgrown and obliterated.

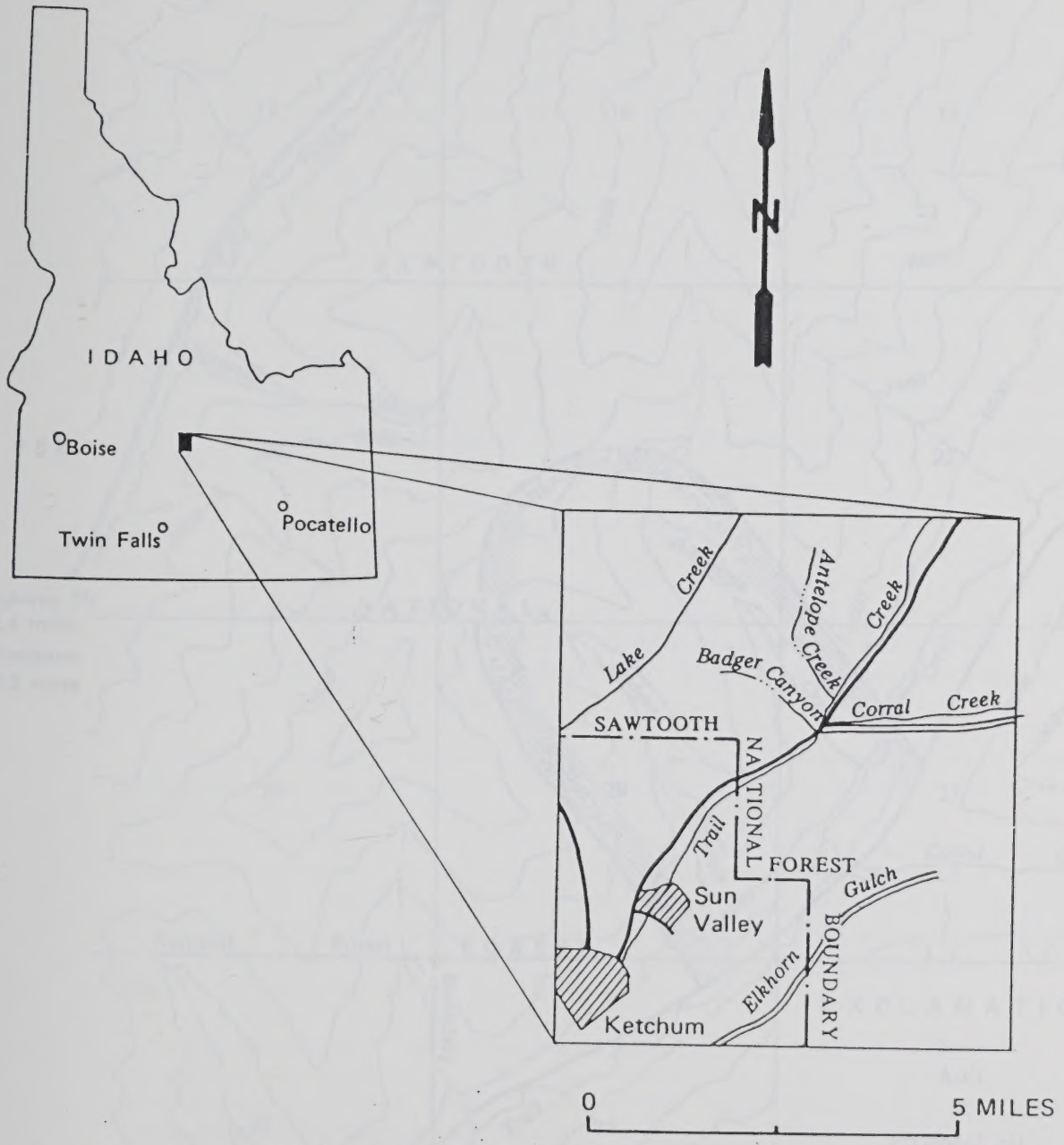


FIGURE 1. - Index map of the Badger Canyon-Antelope Creek site-specific study area.

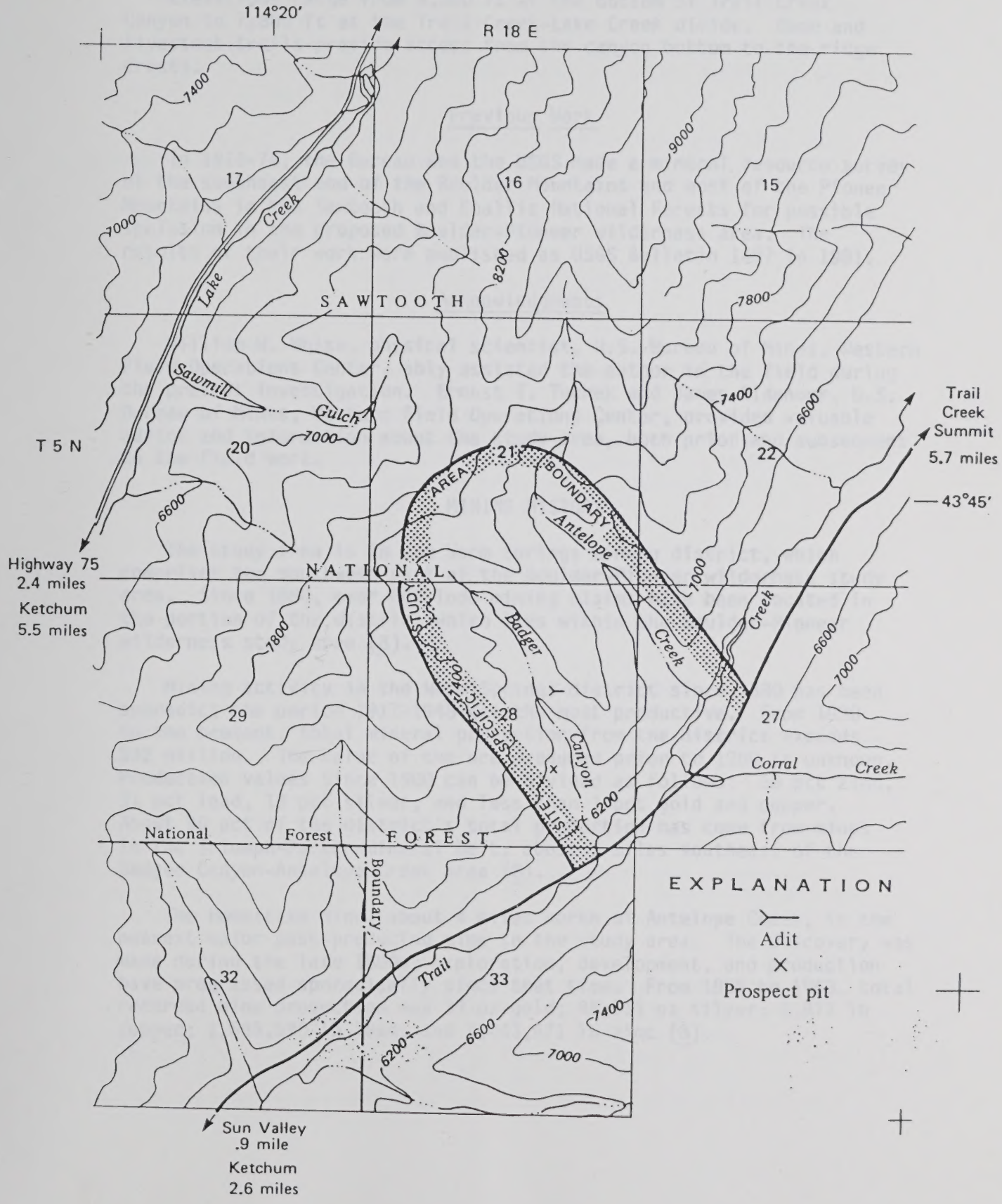
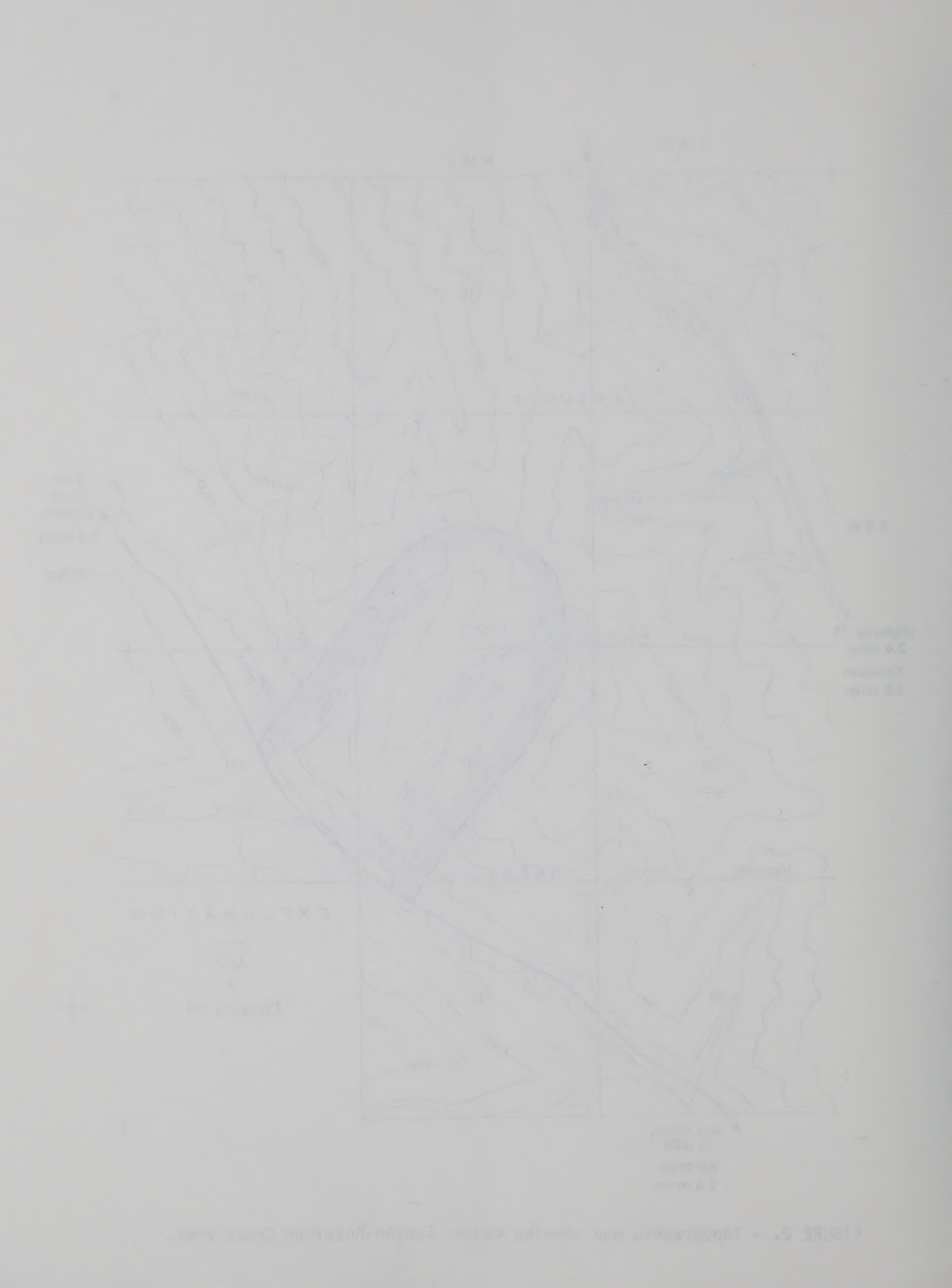


FIGURE 2. - Topographic map showing Badger Canyon-Antelope Creek area.



Elevations range from 6,200 ft at the bottom of Trail Creek Canyon to 7,800 ft at the Trail Creek-Lake Creek divide. Game and livestock trails provide access from the canyon bottom to the ridge crests.

Previous Work

In 1973-74, the Bureau and the USGS made a mineral resource survey of the southeast end of the Boulder Mountains and most of the Pioneer Mountains in the Sawtooth and Challis National Forests for possible inclusion in the proposed Boulder-Pioneer wilderness area. The results of their work were published as USGS Bulletin 1497 in 1981.

Acknowledgments

William W. White, physical scientist, U.S. Bureau of Mines, Western Field Operations Center, ably assisted the author in the field during the present investigation. Ernest T. Tuchek and James Ridenour, U.S. Bureau of Mines, Western Field Operations Center, provided valuable advice and information about the study area, both prior and subsequent to the field work.

MINING HISTORY

The study area is in the Warm Springs mining district, which comprises the southwest part of the Boulder-Pioneer wilderness study area. Since 1880, over 600 lode mining claims have been located in the portion of the district which lies within the Boulder-Pioneer wilderness study area (8).

Mining activity in the Warm Springs district since 1880 has been sporadic; the period 1917-1948 was the most productive. From 1900 to the present, total mineral production from the district exceeds $32 million. The value of the ore produced prior to 1900 is unknown. Production values since 1900 can be divided as follows: 50 pct zinc, 31 pct lead, 19 pct silver, and less than 1 pct gold and copper. About 90 pct of the district's total production has come from mines in the Triumph-Parker mineral belt, about 7 miles southeast of the Badger Canyon-Antelope Creek area (8).

The Homestake Mine, about 4 miles north of Antelope Creek, is the nearest major past-producing mine to the study area. The discovery was made during the late 1800s; exploration, development, and production have progressed sporadically since that time. From 1885 to 1963, total recorded mine production was 33 oz gold; 98,511 oz silver; 9,877 lb copper; 1,585,590 lb lead; and 1,043,471 lb zinc (8).

Several other mines produced small amounts of predominantly lead-silver-zinc ore in the past. Most of these mines have not been worked for many years. In August 1984, developmental work was being done on the north side of Lake Creek Canyon, about 1.5 miles northwest of the site-specific study area.

The history of the small workings found in Antelope Creek and Badger Canyon is unknown. These prospects have not been worked for many years and production, if any, was undoubtedly small.

GEOLOGY

Description of Rock Units

The Badger Canyon-Antelope Creek drainages are underlain primarily by the Milligen Formation (Dm) of Devonian Age (fig. 3). The Milligen consists primarily of "gray-weathering, slabby, phyllitic, or subphyllitic argillite, and black, thin-bedded to massive, carbonaceous to siliceous ("cherty") argillite. Subordinate interbeds of gray, poorly sorted, fine-grained quartzite, yellow-brown- to reddish- or orange-weathering dolomitic siltstone, and rare, thin, beds of blue-gray, silty, micritic to granular bioclastic limestone occur in the lower part of the formation . . . ." (1, p. 33)

The Milligen Formation typically forms steep, grassy, or sagebrush-covered ridges, and steep, talus-covered slopes. This latter characteristic is evident along the north side of Trail Creek Canyon, where the lower slopes are mantled by talus. Soil development tends to be poor above the Milligen Formation.

The Milligen Formation is in thrust fault contact with the overlying Wood River Formation (Pwl and Ppw) which is found as small klippen capping ridges west of Badger Canyon and northeast of Antelope Creek (fig. 3). These klippen are isolated, erosional remnants of the main thrust sheet.

The Wood River Formation, which is Middle Pennsylvanian to Lower Permian Age, is composed predominantly of "fine-grained, calcareous sandstones and quartzites, but includes conglomerate, limestone, shaly limestone, siltite, and argillite . . . . It has been divided into seven units that have a combined stratigraphic thickness of approximately 9,800 ft." (3, p. 90)

"The Wood River Formation tends to form steep-sided ridges and cliffs of moderate to high relief, and weathers to a limy soil that supports a heavier forest growth than does soil developed on the structurally underlying Milligen Formation. Slopes cut in the Wood River Formation commonly are mantled by slide-rock and surface rubble, or are covered by dense vegetation. The best exposures are along Trail Creek road." (1, p. 43)

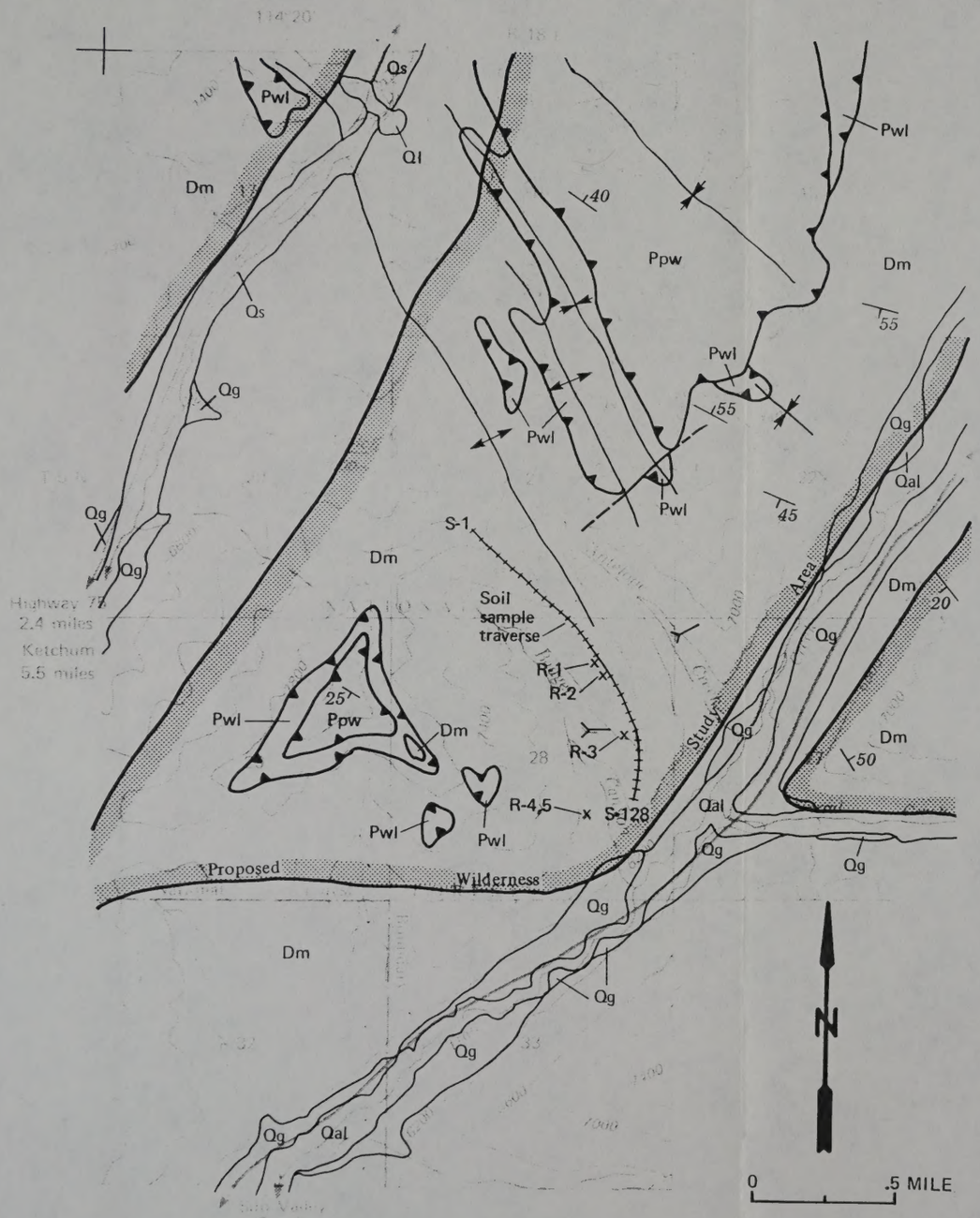


FIGURE 3. - Geologic map of the Badger Canyon-Antelope Creek area [compiled from the U.S. Geological Survey and U.S. Bureau of Mines (9, pl. 2)].

EXPLANATION

Boundary of Boulder-Pioneer Wilderness Study Area

Qal

Alluvium (Holocene)

Ql

Landslide deposits (Holocene)

Qs

Stream deposits, undivided (Holocene and Pleistocene) alluvium and older terrace gravels, some colluvium included

Qg

Terrace gravels (Pleistocene)

Ppw

Wood River Formation (upper part) (Lower Permian to Upper Pennsylvanian)

Pwl

Wood River Formation (lower part) (Middle Pennsylvanian)

Dm

Milligen Formation (Devonian)

Contact

Fault, dashed where approximately located

Thrust fault, sawteeth on side of upper plate

Anticline

Syncline

50

Strike and dip of beds

Adit

x

Prospect pit

S-1

Soil sample locality

R-1

Rock sample locality

The lower unit of the Wood River Formation is the Middle Pennsylvanian Hailey Conglomerate, a distinctive cliff-forming unit of dark, chert-pebble conglomerate and poorly sorted quartzite. The Hailey Conglomerate crops out as a small klippen west of Badger Creek, and is also well exposed as large cliffs in the upper Antelope Creek drainage (fig. 3).

Poorly consolidated surficial deposits are present in the valleys of Lake and Trail Creeks, and in the lower reaches of Badger Canyon and Antelope Creek. These deposits are a mixture of alluvium (Qal), stream deposits (Qs), and terrace gravels (Qg) (fig. 3). The terrace gravels, which also include colluvial deposits, are well developed along Trail Creek near the mouths of Badger Canyon and Antelope Creek.

Structure

The Boulder and Pioneer Mountains lie within a belt of Middle Paleozoic and Mesozoic intense orogenic activity that extended from Mexico to the Arctic Ocean. Huge thrust sheets (allochthons), that are probably of two or more distinct ages and which show a wide range of internal deformational features, juxtapose time-equivalent sedimentary facies. These facies are so different that horizontal displacement of several miles must have taken place (1, p. 55).

The Wood River Formation occupies more than 100 mi^2 in three broad, northwest-trending synclinal belts, which are probably parts of a single, large, folded, and imbricated thrust sheet that originally covered the entire southwest half of the Boulder-Pioneer wilderness study area (1, pp. 42-43). The small klippen of the Wood River Formation which cap the ridges west and north of the Badger Canyon-Antelope Creek drainages are isolated remnants of the larger thrust sheet.

As mentioned previously, the contact between the Wood River and Milligen Formations is a faulted unconformity along which considerable movement has taken place. The lower member of the Wood River Formation, the Hailey Conglomerate, was probably derived in part from, and was deposited on, the underlying Milligen Formation. The Wood River and Milligen were subsequently detached from one another and moved semi-independently, as both were thrust eastward into their present positions (1, p. 45).

MINERAL DEPOSITS

General

Mineral deposits in the Warm Springs mining district are associated with a series of major shear zones which cut the complexly folded and faulted Paleozoic sedimentary rocks. Most of the shear zones strike northwest and dip moderately to the southwest. Mineralization along the shear zones occurs as fissure fillings and as replacements of interbedded limestones. The principal deposits are those of silver-lead-zinc (8, p. 221).

In the Wood River mining district, which lies to the south of the Warm Springs district, the lead-silver deposits are in or near strongly sheared zones, predominantly in contact-metamorphosed siliceous argillite and micritic limestone near intrusive contacts and under the regional Wood River thrust fault (4, p. 582). The deposits near Bellevue, about 18 miles south of Ketchum, are in at least 8 parallel shear zones that strike N. 70° W. in contact metamorphic rocks of the Milligen Formation, which lies between the Wood River thrust fault on the east and the Idaho batholith on the west (4, p. 582).

In the Triumph Mine area, which lies about 6 miles south of Trail Creek, the lead-silver ore occurs in veins striking about N. 70° W., and in replacement deposits at the intersections of shear zones and limestone beds in metamorphosed Milligen Formation, very similar to the ore controls in the Bellevue area (4, p. 582). Because of the widespread, low-grade metamorphism of the Milligen Formation rocks in the Triumph Mine area, the presence of a nearby buried intrusive can be inferred (4, p. 582).

Although the mineralized structures in the Triumph Mine area do not extend into the Lake Creek area, the mineral occurrences are the same and undoubtedly have a similar origin. No intrusive igneous rocks crop out near the study area, but a buried intrusive could well be present nearby.

The lead-zinc-silver deposits in the Warm Springs mining district are probably the result of hydrothermal remobilization of metals from ancient sedimentary rock. According to Hall (2, p. 9), not only are the black shales host and probable sources for the metals in the vein deposits, but some of the productive deposits are stratabound and are probably syngenetic.

Results of Previous Work

Several stream sediment samples were collected in 1973-74 from Badger Canyon and Antelope Creek by USGS geologists. Numerous rock samples were also collected from old adits, prospect pits, and mineralized outcrops. Most of the mineralized rock samples were collected near a 287-ft-long unnamed adit located about 2,500 ft up the Antelope Creek drainage from its intersection with Trail Creek (fig. 2). The analytical results for all USGS samples are summarized in table 1.

The Bureau collected five rock samples from the 287-ft-long adit on Antelope Creek (fig. 2). A 1.2-ft-thick quartz vein and several strong shear zones cut light- to dark-gray argillite and black carbonaceous argillite. The samples contained nil to trace gold, nil to 0.20 tr oz/st silver and trace amounts of copper and lead (8, p. 253, prospect No. 99).

Bureau geologists also sampled an unnamed prospect which lies about 500 ft upslope on the east side of Badger Canyon (fig. 2). The workings consist of two small adits, one about 36 ft long and one caved, and a sloughed trench. A 4-in.-thick, clayey mineralized shear zone in bedded gray argillite strikes N. 20° E. and dips 30° SE. Small pods of galena are found in the country rock to a distance of 6-11.8 in. on the footwall side of the shear zone (8, p. 253, prospect No. 98).

One sample collected across the shear zone and mineralized footwall contained a trace of silver, copper, and lead, and 0.61 pct zinc. A select sample of dump material from the caved adit contained a trace gold, 0.5 tr oz/st silver, a trace copper, 2.89 pct lead, and 2.34 pct zinc (8, p. 253).

Present U.S. Bureau of Mines Study

Soil Samples

Because it had the best-developed residual soil, the ridge between Badger Canyon and Antelope Creek was chosen for a geochemical survey. Soil samples collected from the ridge would more closely reflect the composition of the underlying bedrock than would soil from the canyon slopes which are steep and commonly mantled by talus. Even on the broad ridge top, soil development is poor; the soil cover tends to be less than 12 in. thick, and is very rocky.

The ridge is underlain by argillite of the Milligen Formation. The metasedimentary beds tend to strike northwest and dip to the southwest.

TABLE 1. - Elemental concentration of stream sediments and mineralized rock samples collected by the U.S. Geological Survey from the Badger Canyon-Antelope Creek drainages (7, pp. 85-180)

(Parts per million unless otherwise specified)

Element	Elemental concentration			
	Badger Canyon		Antelope Creek	
	Mineralized rock sample	Stream sediment sample	Mineralized rock sample	Stream sediment sample
Gold	ND	ND	ND	ND
Silver	ND	ND	20 - 500 (4)[1]	ND
Copper	ND	70- 150 (3)	70 - 150 (1)	ND
			>150 (1)	
			700 (1)	
Lead	ND	ND	0.2 - 4 pct (4)	ND
Zinc	ND	300- 700 (3)	>300 (4)	3,000 (1)
				3,600 (1)
Uranium	ND	ND	ND	10 (1)
Molybdenum	ND	10- 20 (2)	ND	ND
Barium	ND	2,000-5,000 (2)	ND	ND
Antimony	ND	ND	700 (1)	ND
Arsenic	ND	ND	10,000 (1)	ND
Mercury	ND	ND	>10 (2)	ND
Beryllium	ND	ND	70 - 150 (2)	ND
Niobium	ND	ND	20 (2)	ND
Tin	ND	ND	30 (1)	ND
Manganese	ND	1,000-5,000 (2)	>5,000 (1)	ND
			3,000 (1)	

ND Not detected.
[1]Number of samples collected at each site.

A soil sampling traverse was run from a saddle on the divide between Trail and Lake Creeks southeast for about 6,250 ft along the ridge between Badger Canyon and Antelope Creek (fig. 3). A total of 128 samples were collected at 50-ft intervals along the traverse. A stainless steel kitchen sieve was used to remove the coarse material during the sampling process, and thus obtain sufficient soil for analysis.

The soil samples were processed at the Western Field Operations Center, and splits were sent to a commercial laboratory for analysis. The analytical results are listed in table A-1.

Statistical Interpretation of Analytical Data

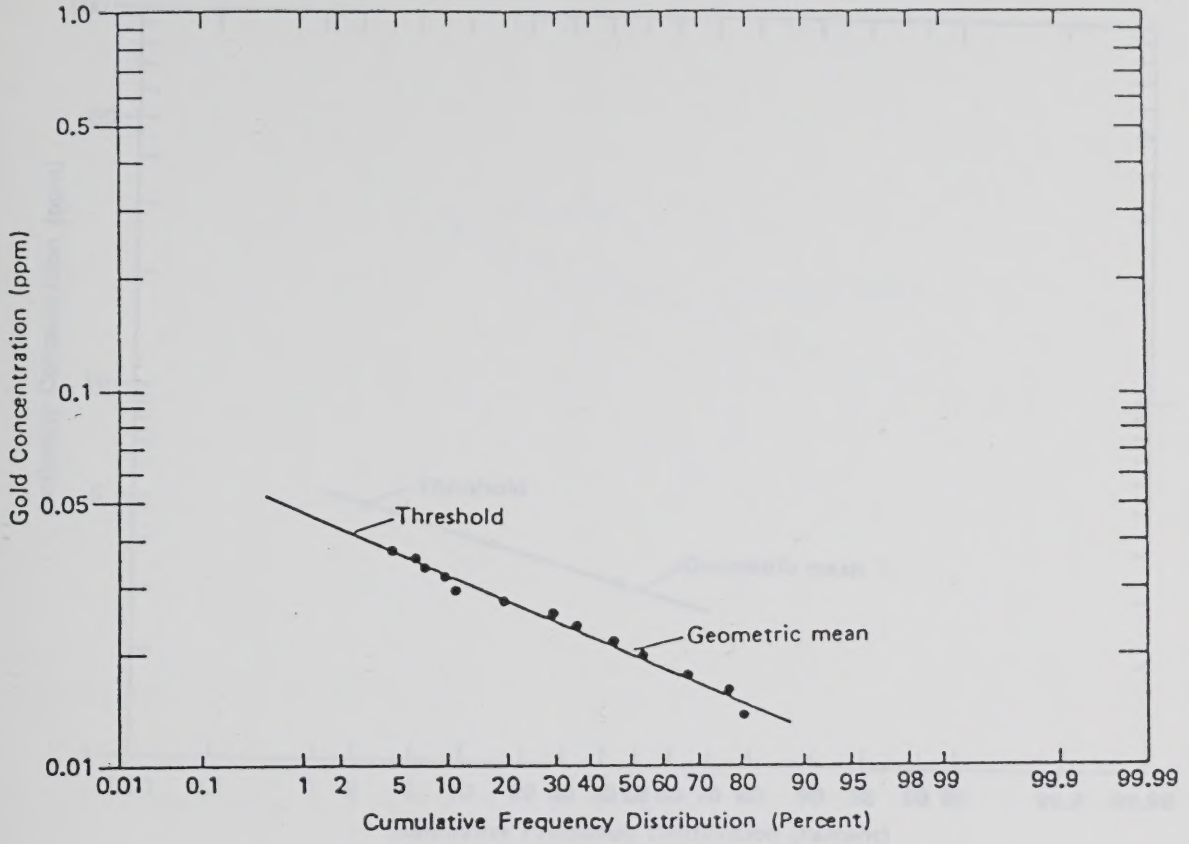
Because the samples were all collected from soil underlain by a uniform rock type, and at about the same depth, the data are amenable to statistical analysis. Statistical methods provide a more scientific and less biased interpretation than nonstatistical techniques. Graphical methods, especially cumulative frequency curves described by Lepeltier (6, pp. 538-550), are particularly useful for illustrating the geochemical distribution of elements in soils.

Where possible, the background, threshold, and anomalous values are determined for each element analyzed. The background is a range of metal concentrations which are in normal abundance for the unmineralized material. The threshold is a selected maximum value above which the metal values are considered anomalous, i.e., having higher than normal background values possibly related to mineralized zones.

The cumulative frequency distributions for gold and silver are shown on figure 4, those for antimony and arsenic on figure 5, and those for vanadium and zinc on figure 6. All of the copper and mercury values and most of the lead and molybdenum values were less than the detection limits for these elements, and thus could not be treated statistically.

The data for gold, silver, and antimony are log-normally distributed (figs. 4 and 5). The data for arsenic does not depart from a straight line distribution except at the lower end of the graph. For elements such as gold, silver, antimony, and probably arsenic which have a single data population, the threshold may be considered the value which is exceeded by 2.5 pct of the total population. The average background value is the concentration at the 50 pct cumulative frequency point on the x-axis of the graph, i.e., the geometric mean represents the average background value.

The data points for both vanadium and zinc do not plot as a single line but as two intersecting lines (fig. 6). Each line is treated as a separate population. The point where the two lines intersect can be considered the threshold. The upper line thus represents the anomalous values, and the lower line the background population.



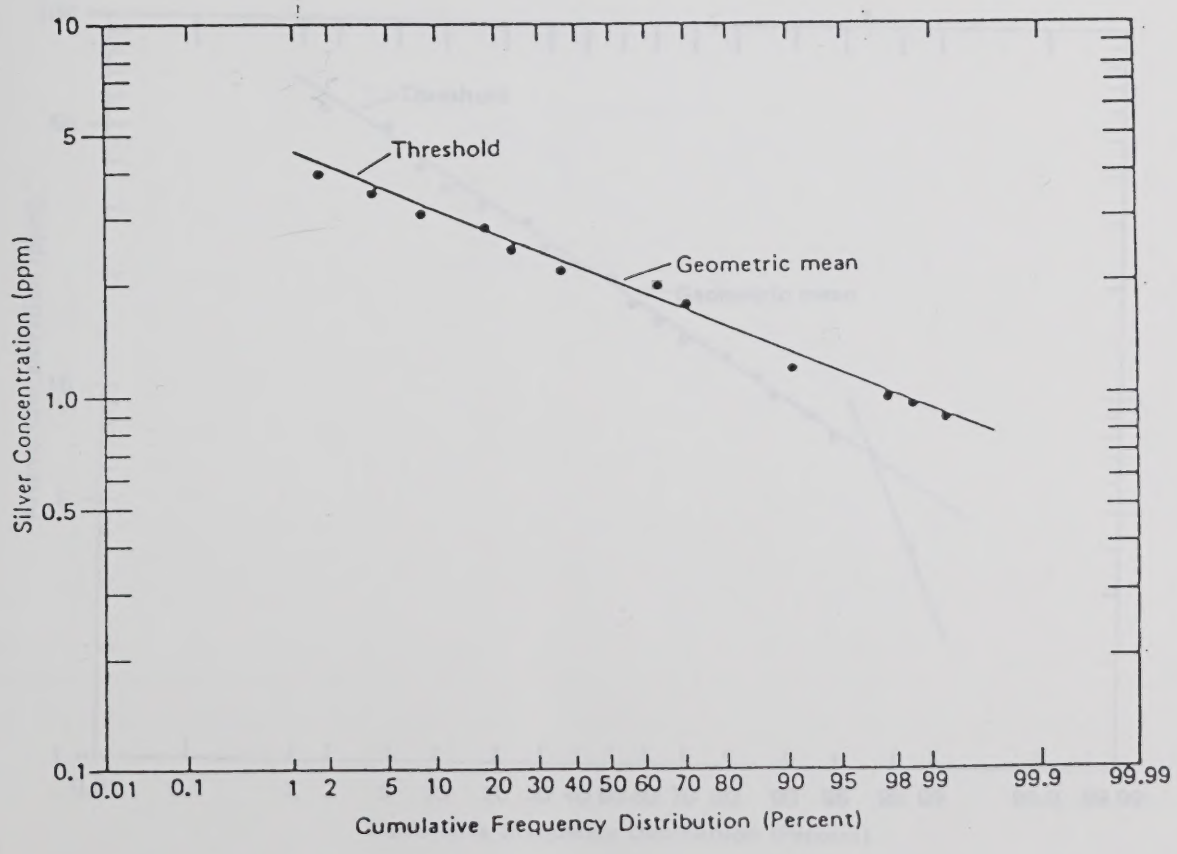
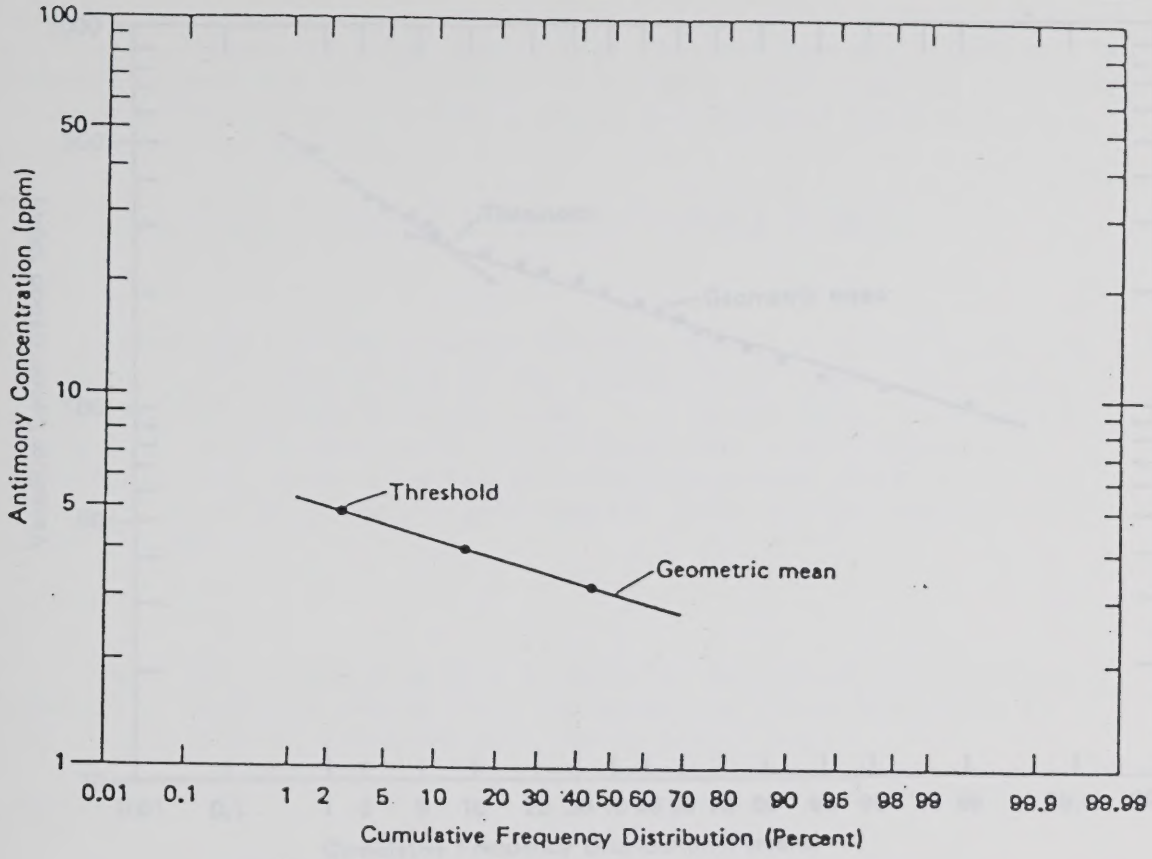


FIGURE 4. - Cumulative frequency distribution for gold and silver in soil samples--Badger Canyon-Antelope Creek area.



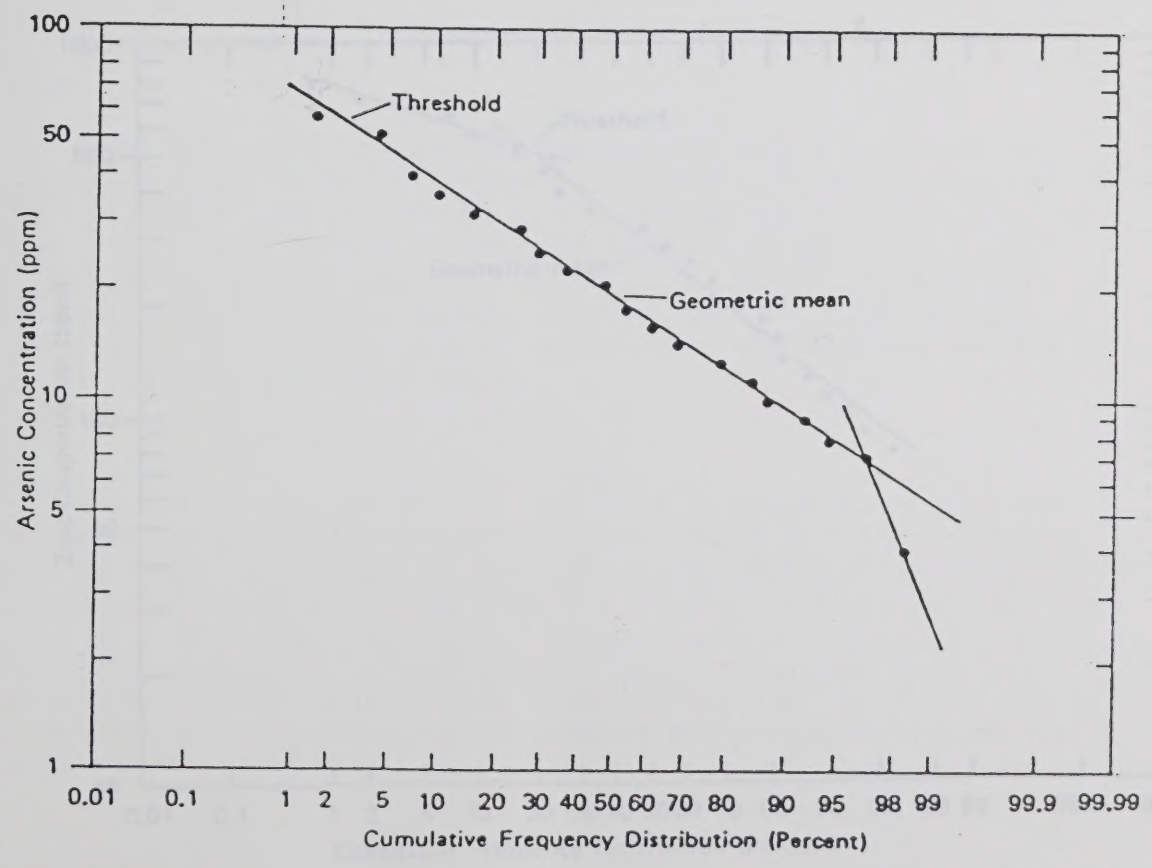
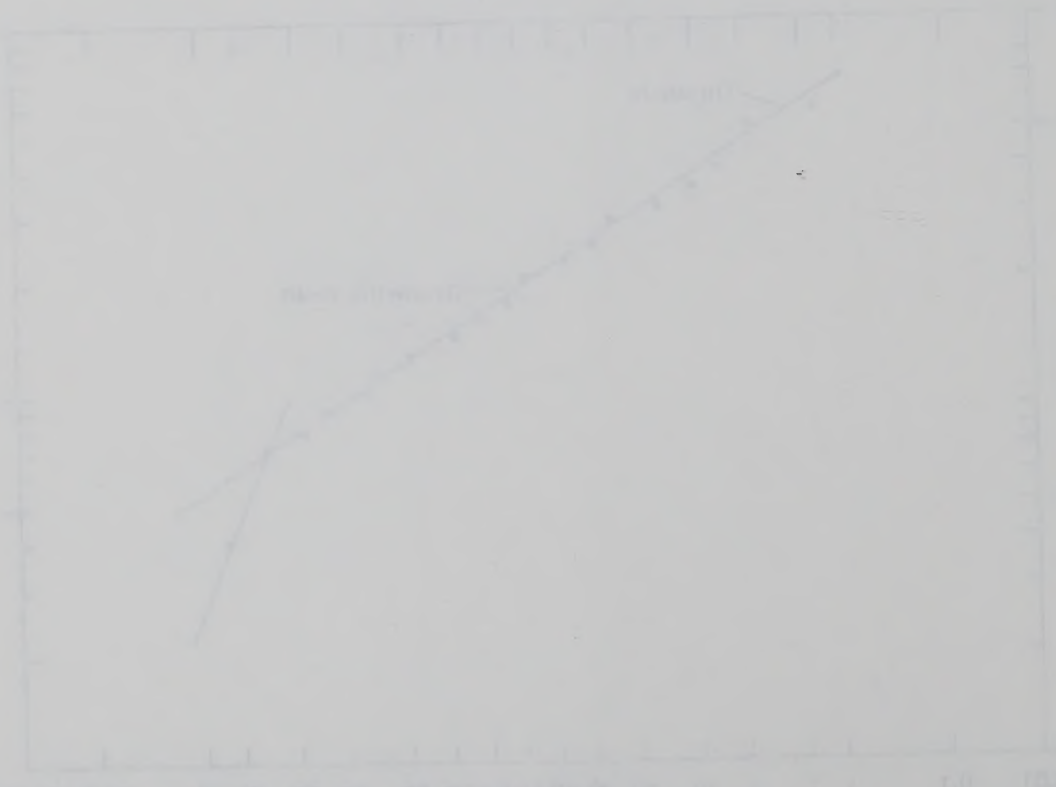
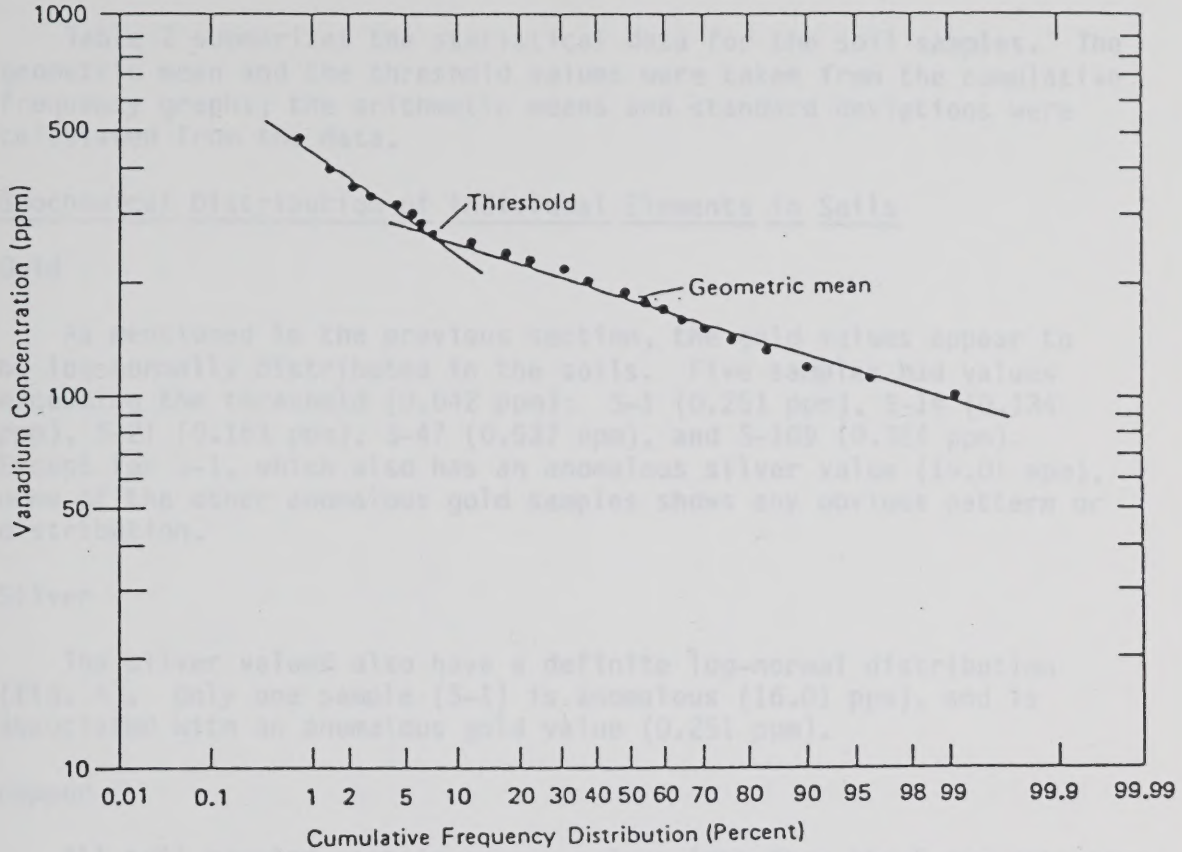


FIGURE 5. - Cumulative frequency distribution for antimony and arsenic in soil samples--Badger Canyon-Antelope Creek area.





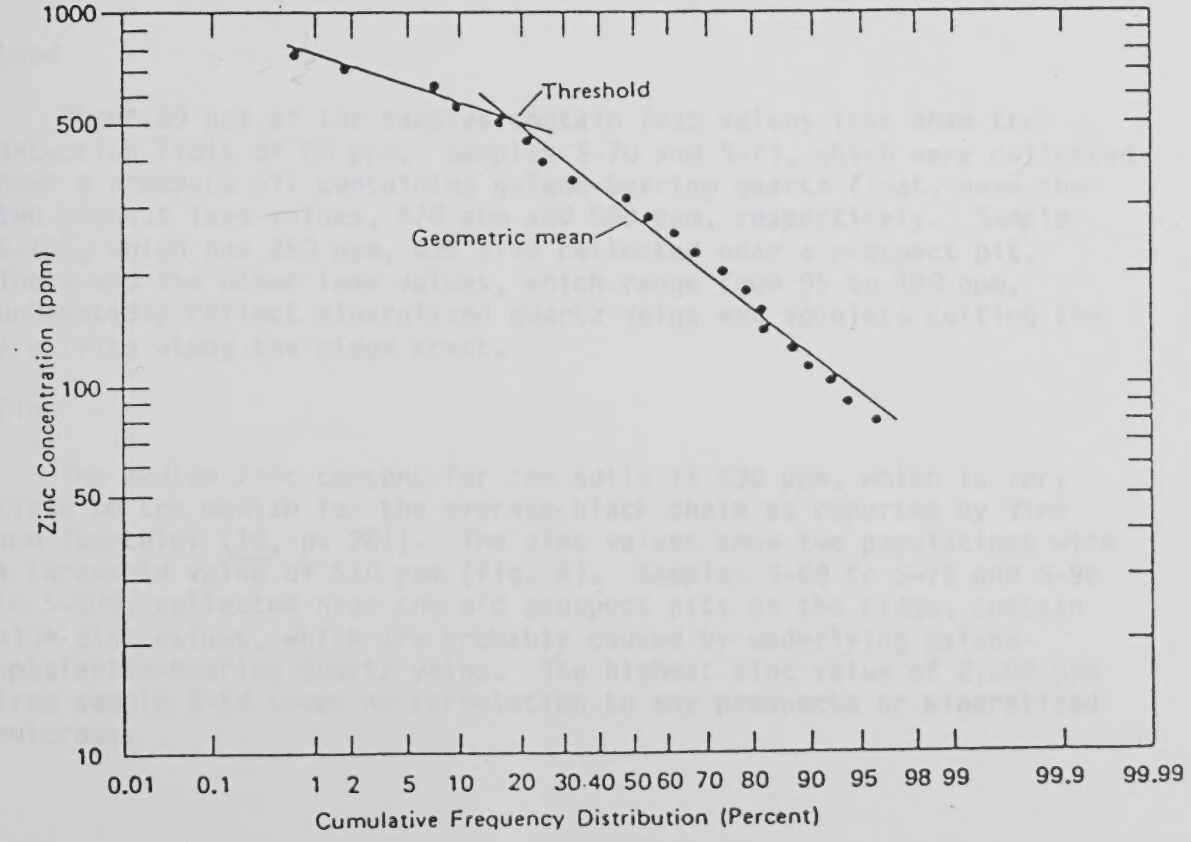


FIGURE 6. - Cumulative frequency distribution for vanadium and zinc in soil samples--Badger Canyon-Antelope Creek area.

Table 2 summarizes the statistical data for the soil samples. The geometric mean and the threshold values were taken from the cumulative frequency graphs; the arithmetic means and standard deviations were calculated from the data.

Geochemical Distribution of Individual Elements in Soils

Gold

As mentioned in the previous section, the gold values appear to be log-normally distributed in the soils. Five samples had values exceeding the threshold (0.042 ppm): S-1 (0.251 ppm), S-14 (0.134 ppm), S-21 (0.161 ppm), S-47 (0.537 ppm), and S-109 (0.354 ppm). Except for S-1, which also has an anomalous silver value (16.01 ppm), none of the other anomalous gold samples shows any obvious pattern or distribution.

Silver

The silver values also have a definite log-normal distribution (fig. 4). Only one sample (S-1) is anomalous (16.01 ppm), and is associated with an anomalous gold value (0.251 ppm).

Copper

All soil samples contain copper values less than the 5 ppm detection limit.

Lead

About 89 pct of the samples contain lead values less than the detection limit of 80 ppm. Samples S-70 and S-71, which were collected near a prospect pit containing galena-bearing quartz float, have the two highest lead values, 470 ppm and 580 ppm, respectively. Sample S-100, which has 250 ppm, was also collected near a prospect pit. These and the other lead values, which range from 95 to 190 ppm, undoubtedly reflect mineralized quartz veins and veinlets cutting the argillite along the ridge crest.

Zinc

The median zinc content for the soils is 290 ppm, which is very close to the median for the average black shale as reported by Vine and Tourtelot (10, p. 261). The zinc values show two populations with a threshold value of 510 ppm (fig. 6). Samples S-68 to S-72 and S-98 to S-100, collected near the old prospect pits on the ridge, contain high zinc values, which are probably caused by underlying galena-sphalerite-bearing quartz veins. The highest zinc value of 2,300 ppm from sample S-54 shows no correlation to any prospects or mineralized outcrops.

TABLE 2. - Summary of soil sample statistical data: Badger Canyon-Antelope Creek area

Element	Total number of samples	Detection limit (ppm)	Number of samples less than detection limit	Lowest value (ppm)	Highest value (ppm)	Geometric mean (ppm)	Median	Threshold (ppm)	Arithmetic mean [calculated (ppm)]	Standard deviation (calculated)
Gold.....	128	0.01	25	<0.01	0.537	0.020	0.020	0.042	0.0219	0.165
Silver.....	128	.700	1	< .700	16.01	2.000	2.000	3.950	1.913	.148
Copper.....	128	5	128	<5	<5	NAp	NAp	NAp	NAp	NAp
Lead.....	128	80	114	<80	580	NAp	NAp	NAp	NAp	NAp
Zinc.....	128	2	5	<2	2,300	280	290	510	308	.359
Molybdenum...	128	2	122	<2	19	NAp	NAp	NAp	NAp	NAp
Arsenic.....	128	2	2	<2	55	19	18.3	57	20.5	.240
Antimony.....	128	2	72	<2	5	3	3	5.1	3.5	.114
Vanadium.....	128	5	0	92	510	180	180	265	173	.134
Mercury.....	128	2	128	<2	<2	NAp	NAp	NAp	NAp	NAp

NAp Not applicable

Molybdenum

More than 95 pct of the soil samples have molybdenum values less than the detection limit of 2 ppm; the highest value was 19 ppm. The molybdenum values, which range from 7.5 to 19 ppm, are irregularly distributed along the soil traverse line.

Arsenic

The arsenic values show a log-normal distribution (fig. 5) and have no particular pattern along the soil traverse. The range of values (<2 to 55 ppm) fall generally within the range for arsenic in soils as reported by Hawkes and Webb (5, p. 360).

Antimony

About 56 pct of the antimony values in the soil samples are less than the detection limit of 2 ppm. All other values range from 2 to 5 ppm, and appear to be log-normally distributed in the soils.

Vanadium

Vanadium concentrations show two populations (fig. 6) and range from 92 to 510 ppm. Nine values lie above the threshold of 265 ppm. The median value of 180 ppm is only slightly above that of 150 ppm reported by Vine and Tourtelot (10, p. 261) for the average black shale.

Mercury

All mercury values in the soil samples are less than the detection limit of 2 ppm.

Rock Samples

Three rock samples (R-1-3) were collected from old prospect pits on the ridge crest near the soil traverse. Two samples (R-4 and 5) were from mineralized outcrops on the west side of Badger Canyon. The analytical results are given in table A-2. The old prospects that were sampled by the Bureau and USGS during the Boulder-Pioneer wilderness study were not resampled.

Sample R-1 is a random chip sample from a sloughed prospect pit near soil sample S-69 (fig. 3). Narrow quartz veins contain sparse galena, which accounts for the anomalous (0.22 pct) lead value in the sample. The zinc content (150 ppm) is not particularly high compared to the zinc contents from nearby soil samples. Sample R-1 contains the highest silver value (1.593 ppm) of all the rock samples. All other elemental concentrations are quite low.

R-2 is a chip sample from a prospect pit about 10 ft east of soil sample S-72 (fig. 3). A white, milky quartz vein, about 15 ft long, 1.5 ft thick, and vertically dipping, trends approximately N. 20° W. The vein material contains iron-stained calcite fragments as well as limonite pseudomorphs after pyrite. All metal values tend to be quite low.

R-3 is from a small dump by a sloughed prospect pit about 20 ft west of soil sample S-100 (fig. 3). The random grab sample consists of white milky quartz containing boxwork structures in vugs but no visible sulfides. Analyses show 1 pct zinc; other values are low (table A-2).

R-4 and R-5 are random chip samples from white quartz veins which crop out near the mouth of Badger Canyon about 200 ft up the west slope (fig. 3). Fissure-filling veins and veinlets containing reddish sphalerite; vug-filling, iron-stained calcite; and siderite have intruded dark quartzite. The veins are exposed in several cuts and trenches along an old sloughed, overgrown access road leading from the valley floor. R-4 contains 220 ppm zinc. R-5 contains 600 ppm lead, 0.43 pct zinc, and 23 ppm copper.

CONCLUSIONS

Soil sampling along the ridge between Badger Canyon and Antelope Creek, combined with limited rock sampling of old prospect pits and quartz vein outcrops, did not reveal any zones of economically recoverable minerals. Anomalous lead and zinc values in the soil samples appear to be related to narrow underlying galena-sphalerite-bearing quartz veins. Quartz veins exposed in three old prospect pits on the ridge between Badger Canyon and Antelope Creek are sparsely mineralized. The galena probably contains silver, and thus gives rise to the anomalous silver values. Anomalous gold values are scattered and erratic.

Copper, molybdenum, antimony, arsenic, and mercury values in the soils are low. Vanadium values are about average for those from black shales.

The Badger Canyon-Antelope Creek area contains numerous old prospect pits and a few caved adits, none of which show any evidence of recent activity. No record exists of any production from any of these workings.

REFERENCES

1. Dover, J. Geology of the Boulder-Pioneer Wilderness Study Area, Blaine and Custer Counties, Idaho. U.S. Geol. Surv. Bull. 1497-A, 1981, pp. 15-75.

2. Hall, W. E. Controls and Characteristics of Mineralization in Middle and Upper Paleozoic Rocks in Central Idaho. Paper in Abstracts of the Symposium on the Geology and Mineral Deposits of the Challis 1° x 2° Quadrangle, Idaho, comp. by F. S. Fisher and K. M. Johnson (Pres. to the Northwest Mining Assoc., Spokane, WA, Dec. 1-2, 1983). U.S. Geol. Surv. Open-File Rep. 83-836, 1983, pp. 8-9.

3. Hall, W. E., J. Batchelder, and R. C. Douglass. Stratigraphic Section of the Wood River Formation, Blaine County, Idaho. U.S. Geol. Surv. J. Res., v. 2, No. 1, 1974, pp. 89-95.

4. Hall, W. E., R. O. Rye, and B. R. Doe. Wood River Mining District, Idaho - Intrusion-Related Lead-Silver Deposits Derived from Country Rock Source. U.S. Geol. Surv. J. Res., v. 6, No. 5, 1978, pp. 579-592.

5. Hawkes, H. E., and J. S. Webb. Geochemistry in Mineral Exploration. Harper and Row, 1962, 415 pp.

6. Lepeltier, C. A. A Simplified Statistical Treatment of Geochemical Data by Graphical Representation. Econ. Geol., v. 64, No. 5, 1969, pp. 538-550.

7. Simons, F. S. A Geological and Geochemical Evaluation of the Mineral Resources of the Boulder-Pioneer Wilderness Study Area, Blaine and Custer Counties, Idaho. U.S. Geol. Surv. Bull. 1497-C, 1981, pp. 85-180.

8. Tuchek, E. T., and J. Ridenour. Economic Appraisal of the Boulder-Pioneer Wilderness Study Area, Blaine and Custer Counties, Idaho. U.S. Geol. Surv. Bull. 1497-D, 1981, pp. 181-292.

9. U.S. Geological Survey, and U.S. Bureau of Mines. Mineral Resources of the Boulder-Pioneer Wilderness Study Area, Blaine and Custer Counties, Idaho. U.S. Geol. Surv. Bull. 1497, 1981, 303 pp.

10. Vine, J. D., and E. B. Tourtelot. Geochemistry of Black Shale Deposits - A Summary Report. Econ. Geol., v. 65, No. 3, 1969, pp. 253-272.

APPENDIX.--CHEMICAL ANALYSES OF SOIL AND ROCK SAMPLES COLLECTED DURING SITE-SPECIFIC STUDY

TABLE A-1. - Analyses of soil samples collected along the ridge crest between Antelope Creek and Badger Canyon

(Parts per million)

Sample number	Au	Ag	Cu	Pb	Zn	Mo	As	Sb	V	Hg
S- 1.....	0.251	16.01	<5	<80	430	<2	15.3	4	240	<2
S- 2.....	.021	1.000	<5	<80	310	<2	<2.0	4	310	<2
S- 3.....	.019	1.000	<5	<80	320	<2	10.9	<2	260	<2
S- 4.....	.020	2.000	<5	<80	240	<2	17.5	<2	230	<2
S- 5.....	<.01	2.511	<5	<80	170	<2	18.6	3	210	<2
S- 6.....	.015	2.267	<5	<80	220	<2	20.7	3	220	<2
S- 7.....	<.01	1.878	<5	<80	170	<2	15.3	3	210	<2
S- 8.....	.015	2.973	<5	<80	150	<2	17.5	3	250	<2
S- 9.....	<.01	2.744	<5	<80	230	<2	29.0	3	280	<2
S-10.....	.022	2.044	<5	<80	140	11	19.7	4	270	<2
S-11.....	.017	1.817	<5	<80	110	<2	13.2	3	220	<2
S-12.....	.017	2.409	<5	<80	87	<2	13.2	3	200	<2
S-13.....	<.01	2.288	<5	<80	84	<2	13.2	<2	230	<2
S-14.....	.134	2.491	<5	<80	95	<2	13.2	<2	250	<2
S-15.....	<.01	1.000	<5	<80	120	<2	<2.0	3	240	<2
S-16.....	.017	2.076	<5	<80	320	7.5	19.7	3	180	<2
S-17.....	.020	2.000	<5	<80	290	<2	16.4	4	190	<2
S-18.....	<.01	2.000	<5	<80	290	<2	14.3	4	180	<2
S-19.....	.015	2.131	<5	<80	260	<2	8.0	3	180	<2
S-20.....	<.01	1.000	<5	<80	180	<2	12.0	3	240	<2
S-21.....	.161	1.906	<5	<80	190	<2	10.9	4	390	<2
S-22.....	<.01	<.700	<5	<80	220	<2	8.7	<2	320	<2
S-23.....	.014	1.821	<5	<80	240	<2	4.0	3	210	<2
S-24.....	<.01	2.000	<5	<80	150	<2	8.0	5	210	<2
S-25.....	.015	2.000	<5	<80	160	<2	8.7	<2	220	<2

Sample number	Au	Ag	Cu	Pb	Zn	Mo	As	Sb	V	Hg
S-26.....	<0.01	1.000	<5	<80	100	<2	4.0	3	180	<2
S-27.....	<.01	1.000	<5	<80	100	<2	12.0	<2	210	<2
S-28.....	.020	3.939	<5	<80	<2	<2	8.7	3	210	<2
S-29.....	.022	1.000	<5	<80	<2	<2	8.7	<2	160	<2
S-30.....	.016	1.000	<5	<80	<2	<2	9.9	3	190	<2
S-31.....	.026	2.000	<5	<80	84	<2	18.6	<2	240	<2
S-32.....	.017	2.123	<5	<80	110	<2	14.3	<2	190	<2
S-33.....	.028	2.038	<5	<80	110	<2	14.3	<2	180	<2
S-34.....	.015	1.880	<5	<80	190	<2	15.3	4	200	<2
S-35.....	.023	1.870	<5	<80	190	<2	12.0	<2	180	<2
S-36.....	.019	1.885	<5	<80	190	13	24.2	4	220	<2
S-37.....	.018	1.787	<5	<80	100	<2	14.3	4	240	<2
S-38.....	.019	2.000	<5	<80	<2	<2	10.1	3	200	<2
S-39.....	<.01	2.000	<5	<80	<2	<2	11.2	3	210	<2
S-40.....	.018	2.116	<5	<80	81	<2	8.0	<2	190	<2
S-41.....	.014	1.000	<5	<80	150	<2	7.0	<2	160	<2
S-42.....	.017	1.000	<5	<80	130	<2	12.2	<2	190	<2
S-43.....	.023	1.796	<5	<80	120	<2	7.0	3	140	<2
S-44.....	.016	1.000	<5	<80	160	<2	9.0	3	130	<2
S-45.....	.016	1.000	<5	<80	160	<2	12.2	<2	150	<2
S-46.....	<.01	3.352	<5	<80	230	<2	10.1	<2	120	<2
S-47.....	.537	2.004	<5	<80	190	<2	10.1	3	110	<2
S-48.....	<.01	1.000	<5	<80	450	<2	24.2	5	350	<2
S-49.....	.017	3.315	<5	<80	390	<2	15.3	3	240	<2
S-50.....	<.01	1.000	<5	<80	640	<2	17.3	<2	200	<2
S-51.....	<.01	2.000	<5	<80	610	11	21.3	<2	240	<2
S-52.....	<.01	2.059	<5	<80	430	<2	22.3	<2	210	<2
S-53.....	<.01	2.139	<5	<80	320	<2	28.9	<2	190	<2
S-54.....	<.01	2.896	<5	<80	2,300	<2	24.2	3	200	<2
S-55.....	<.01	2.124	<5	<80	690	<2	21.3	4	200	<2
S-56.....	<.01	2.870	<5	<80	300	<2	11.2	4	130	<2
S-57.....	.014	3.227	<5	<80	330	<2	7.0	<2	120	<2

Sample number	Au	Ag	Cu	Pb	Zn	Mo	As	Sb	V	Hg
S-58.....	<0.01	2.699	<5	<80	220	<2	14.3	<2	240	<2
S-59.....	.014	2.962	<5	<80	250	<2	9.0	<2	250	<2
S-60.....	<.01	2.077	<5	<80	450	<2	18.3	3	250	<2
S-61.....	<.01	2.700	<5	<80	490	19	47.0	3	510	<2
S-62.....	.021	2.000	<5	160	590	11	32.0	3	300	<2
S-63.....	.026	3.492	<5	100	480	<2	20.3	<2	180	<2
S-64.....	<.01	1.956	<5	<80	370	<2	18.3	<2	180	<2
S-65.....	.025	.880	<5	<80	380	<2	27.1	3	190	<2
S-66.....	.027	2.899	<5	<80	370	<2	26.1	<2	190	<2
S-67.....	.025	2.000	<5	<80	330	<2	24.2	<2	140	<2
S-68.....	.018	2.000	<5	170	640	<2	26.1	<2	190	<2
S-69.....	.022	1.000	<5	<80	550	<2	29.9	<2	170	<2
S-70.....	.016	1.000	<5	470	540	<2	29.9	<2	130	<2
S-71.....	.016	2.379	<5	580	640	<2	34.0	4	160	<2
S-72.....	.025	3.595	<5	95	660	<2	13.2	<2	110	<2
S-73.....	.021	1.000	<5	<80	350	<2	15.3	<2	110	<2
S-74.....	.020	1.000	<5	<80	260	<2	16.3	<2	92	<2
S-75.....	.017	1.000	<5	<80	530	<2	34.0	<2	250	<2
S-76.....	.018	1.000	<5	<80	330	<2	50.0	<2	330	<2
S-77.....	.018	1.000	<5	<80	290	<2	13.2	<2	110	<2
S-78.....	.016	.960	<5	<80	340	<2	18.3	3	110	<2
S-79.....	.023	2.754	<5	<80	250	<2	19.3	3	140	<2
S-80.....	.023	2.005	<5	<80	230	<2	12.2	<2	100	<2
S-81.....	.018	1.862	<5	<80	270	<2	15.3	<2	120	<2
S-82.....	.026	2.116	<5	<80	210	<2	13.2	<2	130	<2
S-83.....	.030	2.117	<5	<80	170	<2	11.2	3	110	<2
S-84.....	.026	2.027	<5	<80	240	<2	14.3	<2	110	<2
S-85.....	.036	2.094	<5	<80	270	<2	28.0	<2	190	<2
S-86.....	.022	2.316	<5	<80	310	<2	34.0	<2	190	<2
S-87.....	.018	2.305	<5	130	430	<2	45.0	<2	250	<2
S-88.....	.019	2.825	<5	<80	330	<2	32.0	<2	200	<2
S-89.....	.021	2.216	<5	<80	330	<2	34.0	<2	190	<2

Sample number	Au	Ag	Cu	Pb	Zn	Mo	As	Sb	V	Hg
S- 90.....	0.026	2.076	<5	<80	330	<2	29.9	5	210	<2
S- 91.....	.027	2.093	<5	83	370	<2	31.0	<2	210	<2
S- 92.....	.020	2.160	<5	<80	310	<2	21.3	<2	140	<2
S- 93.....	.015	2.207	<5	<80	310	<2	55.0	<2	120	<2
S- 94.....	.021	1.989	<5	<80	320	<2	27.1	<2	150	<2
S- 95.....	.016	2.093	<5	<80	310	<2	21.3	<2	150	<2
S- 96.....	.020	2.006	<5	<80	370	<2	28.9	<2	170	<2
S- 97.....	.026	2.083	<5	<80	260	<2	53.0	<2	200	<2
S- 98.....	.028	2.911	<5	110	640	<2	48.0	3	190	<2
S- 99.....	.032	2.385	<5	160	500	<2	29.9	3	130	<2
S-100.....	.024	2.015	<5	250	670	<2	42.0	4	170	<2
S-101.....	.025	2.348	<5	<80	440	<2	29.9	<2	160	<2
S-102.....	.027	2.147	<5	<80	400	<2	18.3	<2	150	<2
S-103.....	.025	1.000	<5	<80	440	<2	14.3	<2	99	<2
S-104.....	.020	1.000	<5	190	510	<2	33.0	<2	150	<2
S-105.....	.029	1.000	<5	<80	630	<2	29.9	3	160	<2
S-106.....	.037	1.000	<5	<80	300	<2	31.0	<2	120	<2
S-107.....	.019	1.000	<5	<80	380	<2	51.0	3	140	<2
S-108.....	.025	1.000	<5	<80	340	<2	20.3	3	100	<2
S-109.....	.354	2.509	<5	130	490	<2	20.3	3	140	<2
S-110.....	.031	2.278	<5	100	590	<2	20.3	4	200	<2
S-111.....	.027	2.064	<5	<80	460	<2	22.3	<2	180	<2
S-112.....	.021	3.114	<5	<80	320	<2	55.0	4	170	<2
S-113.....	.024	3.180	<5	<80	330	<2	15.3	<2	99	<2
S-114.....	.022	1.000	<5	<80	290	<2	28.0	4	140	<2
S-115.....	.023	2.451	<5	<80	210	<2	23.2	4	130	<2
S-116.....	.028	2.714	<5	<80	190	<2	32.0	<2	150	<2
S-117.....	.022	3.432	<5	<80	340	<2	20.3	<2	160	<2
S-118.....	.025	1.000	<5	<80	260	<2	14.3	<2	140	<2
S-119.....	.022	1.000	<5	<80	290	<2	11.2	<2	120	<2
S-120.....	.031	1.000	<5	<80	310	<2	16.3	<2	120	<2
S-121.....	.027	1.000	<5	<80	350	<2	23.2	<2	170	<2

Sample number	Au	Ag	Cu	Pb	Zn	Mo	As	Sb	V	Hg
S-122.....	0.026	2.330	<5	<80	250	<2	21.3	<2	150	<2
S-123.....	.033	1.967	<5	<80	270	<2	20.3	<2	190	<2
S-124.....	.032	1.000	<5	<80	180	<2	19.3	<2	160	<2
S-125.....	.026	1.000	<5	<80	130	<2	17.3	<2	120	<2
S-126.....	.028	2.000	<5	<80	170	<2	19.3	<2	130	<2
S-127.....	.027	1.000	<5	<80	170	<2	11.2	<2	140	<2
S-128.....	.018	1.000	<5	<80	210	<2	12.2	3	140	<2

TABLE A-2. - Analyses of rock samples collected from old prospects in the Badger Canyon drainage

(Parts per million unless otherwise specified)

Sample number	Au	Ag	Cu	Pb	Zn	Mo	As	Sb	V	Hg
R-1.....	<0.007	1.593	<2	0.22%	150	9.7	5.0	<2	<5	<2
R-2.....	<.007	<.300	<2	<30	78	9.4	26.5	<2	45	<2
R-3.....	<.007	<.300	<2	75	1%	8.3	15.1	<2	<5	<2
R-4.....	<.007	<.300	<2	31	220	8.8	5.0	<2	20	<2
R-5.....	<.007	<.300	23	600	.43%	8.5	2.0	<2	<5	<2

BLM Library
Denver Federal Center
Bldg. 50, OC-521
P.O. Box 25047
Denver, CO 80225